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Relationship between the shear modulus of the quadriceps and gastrocnemius muscles and the height of the Drop Jump in basketball athletes
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## INTRODUCTION:

Basketball is a complex contact sport that involves multiple jumps, acceleration, deceleration and changes of movement direction. The mechanical properties of the musculotendinous tissue may be important for understanding the prevalent injuries and athletes performance. Elastography is a technique for assessing, in vivo, the shear modulus which is proportional to tissue stiffness, estimated from the propagation velocity of shear waves generated by high-intensity ultrasonic pulses focused at different tissue depths (1). Using another technique, Ando et al. (2) observed a relation between the stiffness of the medial gastrocnemius muscle and the Drop Jump height of non-athlete individuals, after a training period. There seem to be no studies describing this relationship in basketball athletes. This study aimed to correlate the shear modulus ( $\mu$ ) of the medial and lateral gastrocnemius, vastus medialis and the distal site of the vastus lateralis muscles with the height obtained in the Drop Jump jump test.
METHODS:
Twelve male, competitive basketball players, for more than 5 years, in the sub20 category ( $18 \pm 0.92$ years; $86.5 \pm 17.17 \mathrm{~kg}, 193 \pm 7 \mathrm{~cm}$ ) with no history of lower limb injuries in the last 6 months, were submitted to the jump test protocol Drop Jump (DJ) (Ethic committee 5.776.787). Three trial of DJ tests were filmed and analyzed offline in the Kinovea ${ }^{\circledR}$ application. Three elastographic images of the vastus medialis (VM), vastus lateralis (VL), medial gastrocnemius (MG) and lateral gastrocnemius (LG) muscles of the non-dominant lower limb were acquired at rest, by an experienced examiner (Aixplorer® v. 11 Supersonic Image, Aix-en-Provence, France, linear $40 \mathrm{~mm}, 10-2 \mathrm{MHz}$ ). The averages of the three jumps and three images for each muscle were considered for analysis.
RESULTS:
The average height of the Drop Jump test was $41.23 \pm 4.55 \mathrm{~cm}$. The mean $\mu$ of the VL and VM muscles were 4,23 $\pm 1,32 \mathrm{kPa}$ and $4.25 \pm 0.58 \mathrm{kPa}$, respectively. The mean $\mu$ of the LG and MG muscles were $5.39 \pm 1.26 \mathrm{kPa}$ and 4.65 $\pm 1.06 \mathrm{kPa}$, respectively. Pearsons correlation showed a significant relationship between the DJ height and the $\mu$ of the VL ( $r=0.64 ; p=0.02$ ) and the LG ( $r=0.75 ; p=0.004$ ). CONCLUSION:
Our results with this group, very well trained for jumping, suggest that the muscle components with longer fibers showed a better adaptation to the jump demands. As specialized for contraction velocity (3), these muscles are heavily tensioned during jumps. The analysis of the shear modulus of these muscle groups can be an important factor for monitoring basketball players jump performance.
REFERENCES:

1) Gennisson et al., Diagnostic and Interventional Imaging, 2013.
2) Ando et al., Journal of Electromyography and Kinesiology, 2021.
3) Lieber \& Fridén, Muslce Nerve, 2000.
